California Water and Environmental Modeling Forum

2008
Annual Meeting
Abstracts

"Modeling for Decision Support under Changing Conditions"

February 26-28, 2008

Asilomar Conference Grounds
800 Asilomar Boulevard
Pacific Grove, California

California Water and Environmental Modeling Forum
2008 Annual Meeting Summary of Sessions

Tuesday, February 26, 2008

Time	Session	Moderator	Location
10:15 am-12:00 pm	1: Modeling for the California Water Plan Update 2009	Rich Juricich	Heather
	2: REALM: River, Estuary And Land Model	Eli Ateljevich	Acacia
12:00-1:00 pm	Lunch	---	Dining Hall
1:15-3:00 pm	3: Decision Support Approaches for Climate Change	Armin Munevar	Heather
	4: Delta Hydrodynamics/Particle Tracking	Pete Smith	Acacia
3:00-4:00 pm	Registration	---	Social Hall
4:15-6:00 pm	5: To Panic or Not Panic: Adapting Management of Water Resources for Climate Change	Jamie Anderson	Heather
	6: Overland and Underground Water Integrated Modeling	H. Morel-Seytoux	Acacia
6:00-7:00 pm	Dinner	---	Dining Hall
7:00-10:00 pm	7: Reception I and Poster Session	Mike Deas	Heather, Acacia and Toyon
8:00-8:45 pm	Hugo B. Fischer Award/Presentation by Recipient	KT Shum	
8:45-9:30 pm	Career Achievement Award/Presentation by Recipient	Rich Satkowski	

Wednesday, February 27, 2008

Time	Session	Moderator	Location
7:30-8:15 am	Breakfast	---	Dining Hall
8:15-9:00 am	8: CWEMF Activities / Annual Business Meeting	Tara Smith	Heather
9:00-10:00 am	9: Pop-Up Talks I: 5-Minute Overviews of Modeling Work	Nigel Quinn	Heather
10:15 am-12:00 pm	10: Salmon Modeling, a Medley of Modern Methods	John Williams	Heather
	11: CalLite: CVP-SWP System Screening Model	Sushil Arora	Acacia
	12: 2007 DSM2 Developments and Applications	Tara Smith	Toyon
12:00-1:00 pm	Lunch	---	Dining Hall
1:00-2:40 pm	13: Status and Trends: Putting 2007 in Perspective	Randy Baxter	Chapel
3:00-5:00 pm	14: IEP/CWEMF Joint Session -- Conceptual or Quantitative: How Do You Prefer Your Modeling?	Kevin Reece	Chapel
4:15-5:00 pm	Registration	---	Social Hall
4:15-6:00 pm	15: DRERIP Conceptual Models	Darcy Jones	Heather
	16: 2007 CalSim-III Developments	Hongbing Yin	Acacia
	17: Remote Sensing Data to Estimate Land & Water Use	Rich Juricich	Toyon
6:00-7:00 pm	Dinner	---	Dining Hall
7:00-9:00 pm	18: Keynote Speaker: “Fish Health as a Tool” Tracy Collier, Director of NOAA Environmental Conservation Division	IEP Rep	Chapel

Thursday, February 28, 2008

Time	Session	Moderator	Location
7:30-8:15 am	Breakfast	---	Dining Hall
8:15-10:00 am	19. Post-PPIC Technical Insights for Long-Term Management of the Delta	Jay Lund	Heather
	20. Integrated Watershed Modeling	George Matanga	Acacia
10:15 am-12:00 pm	21: Wanger Delta Smelt Decision I	Paul Hutton	Heather
	22: Quantifying Uncertainties and Sensitivity Analyses in Simulation and Optimization Models	Tariq Kadir	Acacia
12:00-1:00 pm	Lunch / Check-Out	---	Dining Hall
1:15-2:00 pm	23: Pop-Up Talks II: 5-Minute Overviews of Modeling Work	Nigel Quinn	Heather
1:15-3:00 pm	24: Dealing with Modeling Uncertainty: Producing Reasonable Results for Decision Makers	Walter Bourez	Acacia
2:15-4:30 pm	25: Wanger Delta Smelt Decision II	Paul Hutton	Toyon

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Tuesday, February 26, 2008

10:15 a.m.-12:00 p.m.

Session One: Modeling for the California Water Plan Update 2009

Moderator: Rich Juricich (CA DWR)
Location: Heather

Water Plan Stories - Scenario Narratives for the California Water Plan,
David Groves (RAND Corporation) and Rich Juricich (CA DWR)

An overview will be provided on progress in developing scenario narratives for Update 2009 of the California Water Plan. Scenarios represent alternative plausible views of future baseline water management conditions. Scenarios describe factors like population growth and land use changes that are beyond the control of water managers. The Draft Water Plan Assumptions and Estimates Report released this January describes three scenario narratives developed in coordination with the Water Plan Advisory Committee with feedback from other stakeholders. These scenario narratives will form the basis for quantifying future water management conditions in Update 2009.

Cry Me a River – Using the WEAP Model for High Level Scenario Analysis,
David Purkey (Stockholm Environment Institute) and Mohammad Rayej (CA DWR)

Improving on studies completed for California Water Plan Update '05, DWR has applied the WEAP model for high level analysis of agricultural and urban water uses for 10 hydrologic regions under current conditions and alternative future scenarios. We considered water use of 20 agricultural crops and for single-family and multi-family residential indoor/outdoor, commercial, industrial and public water uses. For Update 2009, work is underway to extend the Update '05 analysis to include both water use and water supply sources for agricultural, urban and environmental sectors. To the extent possible, major sources of supply for most regions will be included; e.g. SWP, CVP, ground water, local supplies, desalination, imports, recycled and re-use of return flows. This will provide a direct and straightforward supply-demand analysis in a single tool. Once fully developed, the tool can be used to evaluate water management strategies under different supply-demand scenarios in support of decision makers and managers for high level analysis of statewide water conditions.

New Investments in Water Portfolios, Todd Hillaire (CA DWR)

This presentation describes how the California Department of Water Resources is making new investments in support of improved and more detailed Water Portfolio data. As first presented in California Water Plan Update 2005, Water Portfolios describe actual year conditions in terms of both quantity and quality of water supplies, uses, and the final disposition of those uses throughout California. Characterizing a complete picture of current and historical urban water use data is paramount to analyzing future scenarios and exchanging information for system modeling (e.g. CalSim, C2VSim, etc.). The complete picture encompasses an application with water uses

and balances that have spatial referencing. The application will include all public water supply statistics data, data validation, self supplies water uses (e.g. industrial, golf courses, rural areas) and associated wastewater treatment data, NPDES permits, landscape area, dynamic evapotranspiration of applied water and applied calculations, etc. Each entity and its point of wastewater discharge would be spatially oriented for use by multiple planning processes.

Evaluating Variable ETAW on the South Coast with SIMETAW, Morteza Orang (CA DWR)

The primary goal of this project was to develop a computer application program to simulate daily weather data from monthly means and estimate daily soil water balances for surfaces within the South Coast region that account for evapotranspiration losses and water contributions from rainfall and irrigation. We specifically designed the daily water balance program "South Coast Evapotranspiration of Applied Water" or "SC-SIMETAW" to estimate evapotranspiration of applied water of warm-season grass and agricultural crops in the South Coast region for the water years 1922-2003. The SC-SIMETAW computer application is a modification of the simulation of evapotranspiration of applied water (SIMETAW) application, which was developed to simulate weather data and estimate evapotranspiration of applied water for any location. SC-SIMETAW computes daily reference evapotranspiration, crop coefficient factors, crop evapotranspiration, daily water balance, effective rainfall, evapotranspiration of applied water, etc. for warm-season grass and agricultural crops within each of 13 Detailed Analysis Units in the South Coast region for an 82-year period.

Session Two: REALM: River, Estuary And Land Model

Moderator: Eli Atelevich (CA DWR)
Location: Acacia

Overview of the REALM Development Project, Eli Atelevich (CA DWR)

REALM is a multi-dimensional model collaboration between the DWR, Lawrence Berkeley National Lab, UC Berkeley and GIS visualization developers to create a high performance open model that fits the evolving requirements of the Bay-Delta community. The first component of the project is a 2D hydrodynamic and water quality model. The project design was conceived to envision the key applications (particles, evolving shoreline habitat, floods, levee breaks, 3D subdomains) identified in interviews with Bay-Delta engineers and biologists. REALM is a high performance model, designed from LBNL computational infrastructure to offer scalable performance to large, multi-resolution problems. The algorithms use adaptive mesh refinement to concentrate computation on areas of particular difficulty or interest, and embedded boundaries to conform to natural shores. The model has an open architecture, both for scientific transparency and technical exchange. The talk will briefly discuss one such exchange, a project with UC Berkeley to introduce data assimilation over the Bay-Delta. This talk and session will describe the project goals, how the project components fit together and current status as well as show some intermediate results. We will dedicate time to answer questions, discuss plans for verification and validation, review and participation.

Numerical Methods Used for REALM, Phillip Colella (LBNL)

The Applied Numerical Algorithms Group (ANAG) at Lawrence Berkeley National Lab specializes in the development of accurate, robust and parallelizable models in complex geometries. This talk describes the group, its approach to scientific and engineering problems and experiences with multi-dimensional environmental models. The talk also introduce the Cartesian block-structured embedded boundary methods that are used in the current project and make possible extensions such as 3D modeling and moving boundary problems.

Geometry Processing, Qiang Shu (CA DWR) and Peter Schwartz (LBNL)

Accurate modeling of an estuary requires the calculation of fluxes and forces over a natural domain defined by irregular shoreline and bathymetry. Embedded boundaries are a means for including such information, but EB algorithms impose data requirements on the computational cells such as face apertures and the orientation of the boundary. This talk gives a brief introduction to how geometry is used in the model, and how 3D geometry is considered when calculating 2D fluxes. We describe the geometry preprocessor algorithm and how we robustly interpolate DEM data using a tension spline algorithm from the GRASS suite of GIS tools. We show results on both test geometries and a section of Bay-Delta bathymetry. We describe how we robustly interpolate DEM data using a tension spline algorithm from the GRASS suite of GIS tools.

Discussion

The participants will discuss the REALM Model.

1:15-3:00 p.m.

Session Three: Decision Support Approaches for Climate Change Assessments

Moderator: Armin Munévar (CH2M Hill)
Location: Heather

Hydrologic Variability and the Role of Modeling under Climate Change, KT Shum (EBMUD)

A number of quantitative approaches have recently been proposed to address the effects of climate change on the water system in California. This talk discusses the difficulties in applying some of these methods to assess the water supply reliability from smaller watersheds. Uncertainties in the results from climate models, historical trend analyses, and tree-ring reconstructions render these approaches less useful for planning purposes.

Before deciding on a modeling approach, it would be useful to review the specific goals of the study and the key drivers affecting the results. As an alternative to using a particular hydrologic sequence (or a number of sequences), system performance could be analyzed under design scenarios (which would be no more than a few years in duration) based on different seasonal and inter-annual patterns of runoffs and demands. An application of this approach to a small watershed in the Sierra provides an illustration, and its extension to more complicated systems is discussed.

Scenario Methods for Climate Change Impact Evaluations, Jamie Anderson (CA DWR)

A general methodology using Global Climate Model (GCM) based-scenarios for examining climate change impacts on California's water resources will be presented. Although the general methodology has been applied by several different agencies and research groups in California, each application has its unique approach. This presentation will provide several examples of scenario-based climate change studies for California highlighting the similarities in the applications and discussing the unique contributions of each approach.

Ensemble-Based Methods for Relating Climate Information to Water Resources Planning, Levi Brekke (USBR)

Several approaches might be considered for relating the collective information contained in a large set of climate projections (i.e. ensemble) to water resources planning applications. For example, ensemble evaluation might be used with decision-maker "threshold considerations" to rationally select bracketing scenarios that "sufficiently" span ensemble information for the exploring management sensitivity to projected climate change. Or, the ensemble perspective might be carried forward through runoff and operations analyses, offering a coarse risk assessment relative to the distribution of climate possibilities in a given projection horizon. Examples of both approaches will be highlighted.

Paleoclimate Perspectives of System Vulnerability, Resiliency, and Reliability, Armin Munévar (CH2M Hill)

Recent focus on hydrologic impacts of climate change has led to improved understanding of system performance and vulnerability. While climate change scenarios provide an insight into potential future changes to the hydrologic regime, a broader retrospective view of hydrologic variability can also provide insights into system vulnerability, resiliency, and reliability. Paleoclimate reconstructions are becoming more widely accepted for understanding the vagaries of past climate and augmenting “gaged” observations that span less than a century. Two methods for incorporating paleoclimate reconstructions into future water planning will be examined. Each method leads to improved understanding of system vulnerability, resiliency, and overall reliability

Session Four: Delta Hydrodynamics/Particle Tracking

Moderator: Pete Smith (USGS)
Location: Acacia

Tracking of Smart Particles: Individual Based Modeling of Stripped Bass Population Dynamics in San Francisco Bay, Arash Massoudieh (UC Davis)

As computers gain more computational power, Individual Based Modeling (IBM) is becoming a major option as a tool in ecological investigations. One advantage of IBMs, over distributed-type models, is the ability to capture the impact of a heterogeneous environment on important ecological processes influencing population dynamics such as movement, growth, and food and contaminant uptake, without the need for mathematically burdensome up-scaling techniques. In addition, the up-scaling techniques often require a large degree of simplifications especially in the case of non-linear constitutive relationships whereas IBMs can accommodate these non-linear relationships in their original forms extracted from experimental data.

In this research we have developed an IBM for stripped bass population dynamics in the San Francisco Bay-Delta using a biased Levy Flight run and tumble random walk model. A stochastic method is used to simulate movement, growth and contaminant uptake and mortality of a large population of individual fish in the Bay-Delta. Growth and contaminant uptake of every individual fish is accounted for by a bio-energetic model. The Regional Oceanic Modeling System (ROMS) (Shchepetkin and McWilliams, 2005) is used to model hydrodynamics of the Bay-Delta which is one of the forces affecting fish movement. The run and tumble movement model is biased to account for the driving forces of food availability, more favorable habitats and migration to the spawning zones. A temporal GIS system is developed to store spatial and temporal environmental data such as PCB concentrations, salinity, habitat favorability index, and food availability, among others. These environmental data are mapped onto a structured grid at every time point to be easily accessible by the model. A few demonstration simulations have been performed using the model. Contributors: Erik Loboschefsky, Frank Loge, Timothy Ginn, U.C Davis.

Strategies for Optimizing Computationally Intensive 3D Particle Tracking within the Delta, John Donovan (USGS)

Several strategies were explored for optimizing the run time of particle-tracking simulations. Millions of tracks were calculated to determine the eventual destinations of particles released across the southern and central delta. Outcomes were averaged to create probability and transit time maps showing the effects of release time and location. Because of the large number of releases required, the experiments became limited by computational resources, which lead to various schemes to improve efficiency. Disk caching, multithreading, and a smart release algorithm were employed separately and collectively to find the best effects on throughput. Comparative results of using the strategies will be presented.

Three-Dimensional Particle Tracking Simulations Driven by the Bay-Delta UnTRIM Model, Edward Gross (Bay Modeling) and Michael MacWilliams (River Modeling)

The motivation for this study is the observed decline of Delta Smelt and other pelagic organisms of the upper San Francisco Estuary. A three-dimensional hydrodynamic and particle tracking model is applied to improve understanding of possible reasons/mechanisms for the pelagic organism decline (POD) and the efficacy of any actions taken to sustain pelagic fish populations. The particle tracking model will be used to evaluate the importance of three-dimensional processes in particle tracking methods and model results will be directly compared with "quasi-3D" particle tracking results from DSM2 PTM and from depth-averaged particle tracking results from RMA2. The current phase of work involves hydrodynamic modeling and particle tracking applications to simple test cases and Bay-Delta applications.

The three-dimensional UnTRIM model of San Francisco Bay and the Sacramento-San Joaquin Delta developed as part of the Delta Risk Management strategy (DRMS) is being expanded to the boundaries of the Legal Delta, and when completed will encompass the entire San Francisco Estuary including the full Legal Delta. The resulting model is being calibrated using flow and stage data collected throughout the Sacramento-San Joaquin Delta. Later model calibration and validation work will include simulation of additional periods and comparison with salinity observations. A three-dimensional unstructured grid particle tracking model driven by hydrodynamic results from the Bay-Delta UnTRIM model has been developed for this project. Initial model testing involved test cases with known analytical solutions. The model is being applied to Bay-Delta scenarios and particle tracking model results compared to analogous passive scalar tracer simulation results. Preliminary particle tracking scenarios aimed at Delta Smelt movement explore the effects of simple vertical swimming behaviors.

Particle Tracking in the Combined 1D and 2D Finite Element Network Utilized by the RMA Bay-Delta Model, John DeGeorge (RMA)

Particle tracking is becoming increasingly important for evaluating transport in the Bay-Delta System, particularly for quantification of fisheries impacts associated with export operations. A particle tracking model has been constructed driven by the RMA Bay-Delta Model, which provides a time varying velocity and water quality field in an unstructured finite element network consisting of both two-dimensional, depth averaged and one-dimensional, cross-sectionally averaged elements. This talk presents some of the details of the particle tracking scheme including the methodology of tracking through 1D-2D transitions and 1D junctions and the implementation of dispersion. Several test cases will be presented that demonstrate model performance for pure advection, mixing with spatially varied dispersion, and comparison of particle concentrations with plume concentrations simulated with the RMA Bay-Delta Model.

4:15-6:00 p.m.

Session Five: To Panic or Not to Panic, Adapting Management of Water Resources for Climate Change

Moderator: Jamie Anderson (CA DWR)
Location: Heather

Agencies in Action: How Some California Water Agencies are Dealing with Climate Change, Michael Anderson (CA DWR)

California may see significant changes to its water resources as a result of climate change. Agencies have been acting in the areas of mitigation and adaptation. This presentation will examine some of the recent activities of the California Department of Water Resources and its partners. Contributors: Josue Medellin-Azuara, Kaveh Madani, Marcelo Olivares

Don't Panic, Cooperate: The Potential and Limits of Optimization, Jay Lund (UC Davis)

A variety of studies indicate how greater flexibility and cooperation can greatly reduce the economic costs to California of adverse forms of climate change. While the residual water supply costs remain significant, they remain a very small proportion of California's GDP. The environmental threat of climate change is likely to be much greater, and could increase difficulties for urban and agricultural water supplies. One potentially important environmental aspect of climate change is cold water pools for downstream fish habitat; some early optimization of reservoir temperature operations is presented.

Indemnifying Hydropower Generation Against Climate Change, Kaveh Madani (UC Davis)

Climate warming is expected to shift the runoff peak from spring to winter in California as a result of the reduction in snowpack. The Sierra's high-elevation system supplies roughly 74 percent of California's in-state hydropower supply and is composed of more than 150 power plants with relatively small reservoirs associated with them. Such low capacity reservoirs have been designed to take advantage of snowpack, the natural reservoir. With climate warming, the adaptability of the high-elevation hydropower system is in question as a shift in runoff peak can have important effects on generation and its economic value. By developing a non-linear optimization model which uses historic real time hourly data, the changes in optimal hydroelectricity generation of 137 hydropower plants in Sierra are simulated under three different climate warming scenarios (dry warming, wet warming, and warming only) for a 15 years period, covering dry, wet and average hydrological years. These results are then compared to the historic generation to investigate the possibility of indemnifying Sierra's high-elevation hydropower against snowpack reduction and the adaptability of the system to climate warming.

Statistically-Downscaled WCRP CMIP3 Climate Projections, Levi Brekke (USBR)

Reclamation has teamed with Lawrence Livermore National Laboratory, Santa Clara University, and The Institute for Research on Climate Change and its Societal Impacts to develop a web-served, public-access archive of downscaled climate projections. The archive includes statistically downscaled translations of 112 projections produced through the World Climate Research Programme's Coupled Model Intercomparison Project phase 3 effort (temperature and precipitation, monthly time-step, 1950-2099, 1/8º spatial resolution, contiguous U.S. coverage). The purpose of the archive is to improve data access for planning analysts seeking climate projection information. The web-service supports custom data requests and enhances the abilities of researchers and decision-makers to assess possible future climates at a region-scale,

explore societal impacts, and approach planning response from a risk-based perspective. Presentation will highlight archive scope, content, downscaling methodology, and application examples.

Session Six: Overland and Underground Water Integrated Modeling

Moderator: Hubert Morel-Seytoux (Hydroprose International Consulting)
Location: Acacia

Linking Groundwater to Cropping Patterns in a Model of the Klamath Project, Brian Joyce (SEI-USA)

The Klamath Basin Hydrologic/Economics Model (KBHEM) is an extension to Reclamation's water planning model, KPSim, that is used to simulate the internal operations of the Klamath Project and to analyze economic implications of various operational and management strategies. The tool has been used to carry out economics analysis and to identify impacts to Klamath Project deliveries for a range of potential settlements under consideration by parties in the region. Recent directions in basin-wide planning create the need for a more integrated analytical approach. The ability of irrigation district practices to react dynamically to evolving water supply and economic conditions is now a required element of basin-wide studies. In addition, water supply conditions, and in particular access to groundwater, changed dramatically in 2001 when many wells were installed to compensate for the reduction in surface water deliveries. Finally, the economic context of the farming enterprise in the region has also changed in response to standard shifts in input costs and commodity prices and to local losses of long standing production contracts. In light of these realities, we revised the KBHEM model such that cropping choices (and by association water demands) were governed by surface water availability and the cost of pumping groundwater.

Estimating Regional Impacts of Conjunctive Use with an Integrated Hydrologic Model of California's Central Valley, Charlie Brush (CA DWR)

Conjunctive use programs that substitute groundwater for surface-water diversions impact several components of the regional hydrologic system. The California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM), an integrated hydrologic model of the alluvial portion of California's Central Valley, was used to simulate the effects of a regional conjunctive use program on the groundwater and surface-water flow systems of the Sacramento Valley. The simulated scenario utilized groundwater in lieu of scheduled surface-water diversions during periods of low surface-water availability, thereby increasing in-stream flows to the Sacramento-San Joaquin Delta. The C2VSIM model was used to estimate the effects of this scenario under the hydrologic and land-use conditions that occurred between October 1972 and September 2003. The conjunctive use program was operated in 20 of the 31 years. On average, 70% of the water that was left in the river system reached the Delta, with the remainder representing decreased groundwater discharges to streams. There was significant annual variation in the amount of water reaching the Delta, with substantial declines occurring when the project was operated for several years in succession. These results demonstrate the benefits of using an integrated hydrologic model to simulate the regional impacts of conjunctive use projects.

The Integrated Hydrologic Model: Concepts and Applications, Alaa Aly and Patrick Tara (INTERA, Inc.)

The Integrated Hydrologic Model (IHM) integrates the significant surface and subsurface hydrologic processes for the land based portion of the hydrologic cycle into a single software package. Through the coupling of surface water and ground water process models and the explicit representation of the vadose zone, IHM provides a state-of-the-art public domain

windows-based capability to simulate the interaction between surface water and ground water. IHM uses physically-based delineations of land forms into land segments. Each land segment represents a homogeneous hydrologic response unit (HRU) within a drainage basin. A unique land segment is created by intersecting the drainage basins, land use, and soils coverage. IHM parameters are directly derived from land cover and soil data. This presentation focuses on the hydrologic integration processes as implemented in IHM as they relate to the behavior of simulated evapotranspiration rates, groundwater recharge, and surface runoff and their relationships to the IHM-controlling parameters. Two applications will be described to illustrate the model's ability to simulate large regional systems and model validation on a highly-monitored small watershed.

Decision Support Tools for Integrated Regional Water Management Planning,
Ali Taghavi (WRIME)

The Integrated Regional Water Management Act of 2000 has mandated the development of regionally feasible alternative solutions to the water issues that the water managers face. These include issues with respect to both water demand and supply and their reliability, as well as water quality. The regional solutions to the water problems are inherently dependent on solutions to the problems at the local level. On the other hand, often times the local problems cannot be addressed without an over-arching solution to the water problems at a regional level. The local solutions, however technically sound, often times cannot be implemented due to the constraints and limitations on institutional, political, and financial means. The State and federal agencies have allocated significant funding opportunities for the local and regional institutions to develop regionally sound and reliable solutions to the water problems throughout the state. Analytical models have played an important role in the analysis of reliability, effectiveness, impacts, and cost-benefits of the regional projects. In order for these models to be an effective tool for IRWM project evaluation, they should address the regional problems, while providing means to assess the local problems. This dual scale analysis has posed some challenges to the modeling community for development of effective and accurate models. This talk will present some of the challenges and potential venues in the development and application of hydrologic, hydraulic, and economic models as they are used for regional and local planning purposes. In addition, new decision support tools and technologies for use in the regional and local planning projects will be presented.

7:00-10:00 p.m.

Session Seven: Evening Program

Moderator: KT Shum (CWEMF Past-Convener/EBMUD)
Location: Heather, Acacia and Toyon

7:00-10:00 p.m. Reception and Poster Session

Please see poster abstracts at the end of this document.

8:00-8:45 p.m. Presentation of the Hugo B. Fischer Award

The CWEMF Hugo B. Fischer Award, which is made in honor of Dr. Hugo B. Fischer's pioneering work on water quality modeling for the Bay-Delta system, recognizes pioneering contribution(s) to the use of modeling for understanding or solving California water problems. More specifically, the award, which was conceived and endowed by Lyle Hoag, retired Executive Director of California Urban Water Agencies and a co-founder of the CWEMF, is given annually for (1) innovative development, refinement, or application of a computer model or (2) significant furtherance of the

effective use of models in open forums for planning or regulatory functions that benefit California water stakeholders and decision makers.

Remarks by the Hugo B. Fischer Award Recipients

The recipient will discuss the modeling-related work associated with the award.

8:45-9:30 p.m. Presentation of the Career Achievement Award

The CWEMF Career Achievement Award is given annually to individuals for significant contributions over their career in developing, using or promoting computer modeling to analyze California's water-related problems. More specifically, the CWEMF Career Achievement Award recognizes sustained and significant contributions that (1) increase the usefulness of models in water management analyses in California, (2) promote sound quantitative analyses in water management decisions and (3) raise public awareness and improving public acceptance of the role of modeling.

Remarks by the Career Achievement Award Recipient

The recipient will discuss the modeling-related work associated with the award.

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Wednesday, February 27, 2008

8:15-9:00 a.m.

Session Eight: CWEMF Activities / Annual Business Meeting
Moderator: Tara Smith (CWEMF Convener / CA DWR)
Location: Heather

The CWEMF will (1) report on 2007 model user groups, peer reviews, technical workshops, and administration activities and (2) hold its Annual Business Meeting.

9:00-10:00 a.m.

Session Nine: Pop-Up Talks
Moderator: Nigel Quinn (LBNL/USBR)
Location: Heather

Pop-Up Talks: Five-minute overviews summarizing California water and environmental modeling work.

10:15 a.m.-12:00 p.m.

Session Ten: Salmon Modeling: A Medley of Modern Methods
Moderator: John Williams (Consultant)
Location: Heather

Hierarchical Modeling of Juvenile Chinook Salmon Survival in the Lower Portions of the San Joaquin River System using Paired Coded-Wire-Tag Release-Recovery Data,
Ken Newman (USFWS)

Aiming to estimate the freshwater survival of outmigrating juvenile Chinook salmon through the lower portions of the San Joaquin river, paired releases of coded-wire-tagged salmon have been made at several locations in the lower river since the mid-1980s. These fish were recovered downstream by in-river trawl samples and in samples taken from ocean fishery catches. Hierarchical models, which account for between release-pair variation as well as catch sampling variation, were fit to the release-recovery data. Different structural sub-models for the survival through specific reaches were examined with attention focused on the relationship between survival and flow, water exports, and the presence or absence of a barrier at the head of a waterway (Old River) which passes directly by the export pumping facilities. The presence of the barrier was associated with an increase in survival. Between release pair variation in survival probabilities was generally quite large.

A Generic Robust Design for Monitoring Steelhead Runs using PIT Tags: Relationship between Effort and Precision, David Boughton (NMFS)

Historically, steelhead were the most widespread anadromous salmonid in California, and are currently the focus of extensive and intensive recovery efforts. Time-series data on the annual run sizes of wild steelhead populations are perhaps the single most useful kind of data in assessing the progress of recovery and the overall effectiveness of various management actions. Unfortunately, estimates of the sizes of steelhead runs are difficult to make for a variety of technical and logistical reasons. However, PIT tag technology has advanced to the point where tagged fish can be detected "in situ" (without recapture), and this has opened up some promising new strategies for monitoring run size. Here, I describe some computer simulations and statistical models that explore various design issues of this approach, which can be considered a special case of Pollack's robust design for mark-recapture studies. My focus is to use Bayesian hierarchical versions of the robust design to explore the relationship between tagging effort and the precision of run-size estimates. The goal is to obtain insights about the potential of the PIT-tagging approach for monitoring anadromous runs.

Investigating the Role of Environmental Drivers and Density-Dependent Mechanisms on Recovery of Central Valley Chinook, Noble Hendix (R2 Consultants)

Density dependent mechanisms may have important consequences for restoration of salmon populations (Greene and Beechie 2004 CJFAS 61:590). Population models that can correctly predict responses of Chinook populations to restoration actions may therefore need to incorporate density dependence in specific life history stages. Furthermore, environmental covariates may determine the levels at which density dependent processes operate, for example by determining carrying capacity. Since those environmental covariates are dynamic, the carrying capacity also changes over time. Hypotheses about the influence of particular environmental covariates may be generated through simulation models; however, quantifying the influence of those covariates for a specific population requires fitting model predictions to observed indices of abundance. Such statistical population models (i.e., fitting to data) provide an opportunity to evaluate alternative hypotheses by allowing the data to provide support for certain hypotheses over others. This framework can be used to identify how environmental covariates may be affecting density dependent processes. We present several conceptual models that will be applied to winter and spring run Chinook populations in the Central Valley. These models include a method for estimating the influence of environmental covariates on density dependence by fitting specific life history stage to available data. Contributors: Bob Lessard, University of Washington, Seattle, WA Ray Hilborn, University of Washington, Seattle, WA

The Sacramento Ecological Flows Tool (SacEFT): Expanding and Communicating Ecological Considerations Used to Evaluate Water Management Alternatives on the Sacramento River, Clint Alexander (ESSA Technologies Ltd) and Ryan Luster (TNC)

Water planning efforts on Sacramento River currently consider few ecosystem components, such as maintaining minimum in-stream flows and temperature requirements, or influencing Delta exports to reduce entrainment losses. Most of these in-stream flows have been developed with a focus on few species. Results of the Sacramento River Ecological Flows Study (the “Study”) initiated by The Nature Conservancy (TNC) and partners are now available (www.delta.dfg.ca.gov/erp/sacriverecoflows.asp). The Study synthesizes two decades of restoration work by TNC and its partners in the riparian corridor of the Sacramento River. The Sacramento Ecological Flows Tool (SacEFT) component of this project links flow management actions to focal species (chinook salmon, steelhead, green sturgeon, western pond turtle, bank swallow, and Fremont cottonwood) outcomes to improve the ecological representativeness of water operations. The system leverages existing physical datasets from accepted planning tools like CALSIM-SRWQM-HEC5Q rather than reinventing wheels, and selectively "builds-in"

functional relationships for focal species performance measures. SacEFT can provide guidance on both target flows (to maximize ecological benefits) and avoidance flows (to minimize negative consequences), bracketing the range of discharges to be evaluated experimentally. In the end, our multiple focal species approach reduces the shortfall in ecological evaluation capability. Ultimately, the long-term goal is to work with leaders in water planning forums to continue the development of SacEFT to best meet the needs of these groups.

Key contributions of the SacEFT component of the Study are as follows: Improves the basis for evaluating flow alternatives on the Sacramento River with a single computer program that expands focal species considerations, linking performance of 6 species (35 habitat-centered performance measures) from Keswick to Colusa with flow, water temperature, gravel, and channel revetment actions. Provides for multiple levels of communication of information ranging from simplified formats for managers and decision-makers to in-depth displays of detail functional relationships and transparent assumptions for review by technical experts leverages existing systems and data sources (CALSIM-SRWQM-HEC5Q modeling complex; historical gauging station records, the meander migration model, and TUGS). SacEFT does not reinvent their functionality but acts as an "eco plug-in" compatible with major water-planning models Catalyzes exploration of new alternatives and helps promote the development of needed flexibility in the water management system.

Session Eleven: Development of CalLite: CVP-SWP System Screening Model

Moderator: Sushil Arora (CA DWR)
Location: Acacia

Introduction to CalLite Screening Model Development, Francis Chung (CA DWR)

CalSim, developed by the Department of Water Resources, CA (DWR) and US Bureau of Reclamation (USBR), has been used for planning and management of State Water Project and Central Valley Projects in California. The simulation model is comprehensive in terms of detailed hydrology and water resources system representation, and well suited for feasibility studies and EIR/EIS documentation process. However, the model requires high level of expertise, skills and experience to perform any study due to complexity of the water resources system. Recently DWR and USBR initiated development of a rapid, interactive screening model for Central Valley water management proposals. This screening tool, named CalLite, simulates the hydrology of the Central Valley, reservoir operations, project operations and delivery allocation decisions, Delta salinity responses to river flow and export changes, and habitat-ecosystem flow indices. While CalLite maintains the hydrologic, operational and institution integrity as represented in CalSim, the tool is easy to use and reduces runtime significantly. The simulation results obtained from a typical CalLite run are within 5% of a corresponding CalSim run while CalLite run time is less than 5 minutes.

Innovative Features of CalLite Screening Model and a Live Demo, Nazrul Islam and Sushil Arora (CA DWR)

CalLite was developed using the GoldSim system dynamics software which enables simulation of complex process through a build-up of simple object relationships, incorporates Monte-Carlo stochastic methods, and includes dynamic, interactive user interfaces. CalLite simulates water conditions in the Central Valley over an 82-yr planning period in under 5 minutes and allows interactive modification of a variety of water management actions including alternative conveyance options, off stream storage reservoirs, groundwater management programs, demand management, and river and Delta channel flow and salinity targets. The screening tool is designed for use in a variety of stakeholder processes for improved understanding of water

system operations and future management. CalLite can simulate observed hydrologic regimes or future possible climate change hydrologic regimes. The tool bridges the gap between more detailed system models (CalSim) managed by DWR and Reclamation and policy/stakeholder demand for rapid and interactive policy evaluations. CalLite can be applied to assist in the screening of a variety water management options and to educate decision makers on system responses.

Example Implementations of Water Management Actions using CalLite, Erik Reyes (CA DWR)

Various Water Management Actions that may potentially provide benefits for fish mortality, water quality, and water supply reliability are being studied throughout the state. Example Water Management Actions such as an Isolated Facility, Shasta Enlargement, Conjunctive Use, North-of-Delta Off-stream Storage and others were implemented with the CalLite Screening Tool. The example implementations were developed to demonstrate the flexibility of the tool to investigate varied types of water management actions. The examples were also developed to exhibit the tools ability to reasonably match the results of companion CalSim implementations.

CalLite Forecast Allocation Module, Randi Field (USBR)

The Forecast Allocation Module water supply allocation procedure of the CVP and SWP demonstrates the flexibility and modularization of the CalLite screening tool. The most recent development, the CVP portion, simulates the allocation procedure and attempts to more closely mimic the real-time forecast allocation decision process. The module or "sub model" features an iterative approach rather than the other optional module which uses a water supply and delivery index to allocate water supply resources. The forecast based procedure is embedded within a "planning" mode and is triggered each March – May resulting in an adjusted allocation for the current month through the end of September. Although this first application reveals the module's potential, future explorations will also be discussed.

Explorations in Hydroclimate, Demand, and Delta Uncertainty, Armin Munevar (CH2M Hill)

While CalLite simulates the hydrology and operations over much of the same geographic area as the CALSIM model, there are several features in the CalLite screening model that are unique and deserve to be highlighted. These innovative features permit a range of analyses to be conducted that are distinct from those that can be reasonably performed in existing system models. Amongst the features to be presented are methods for incorporating hydroclimate uncertainty and climate change, methods for incorporating a wide range of SWP and CVP demands, and exploring future Delta management uncertainties. CalLite has provided flexibility in these and other areas such that possible future changes can be explored.

Session Twelve: 2007 DSM2 Developments and Applications

Moderator: Tara Smith (CA DWR)
Location: Toyon

Magnitude of Dispersions Factors in DSM2 - What Values are Appropriate?, Qiang Shu (CA DWR)

When modeling with DSM2-QUAL, the key parameter affecting mixing is the dispersion factor, a calibrated parameter applied independently to each channel reach. The dispersion factor differs from the classical dispersion coefficient described in Fischer' "Mixing in Inland and Coastal Waters". This presentation discusses how the DSM2 and classical dispersion formulas relate to one another and how to determine reasonable ranges for the DSM2 coefficient based on estimates in the literature.

Real-Time DSM2 Simulation: An Update,
Abdul Khan, Amrit Sandhu, and Tracy Hinojosa (CA DWR)

The Delta Compliance and Modeling Section of the Project Operations Planning Branch of the Operations & Maintenance Division of DWR has been using DSM2 simulation results to ensure compliance of State Water Project operations with regulatory Delta water quality, flow, and export restriction regulations, as well as with other requirements such as south Delta water level objectives during water transfers or use of Joint Point of Diversion. In recent times, a process has been initiated to continue to simplify the steps to run DSM2 for real-time forecasting purposes, as well as to put in place an on-going procedure to periodically update documentation for real-time DSM2 simulation. This presentation provides an update of these recent activities to further improve the capabilities of the Delta Compliance and Modeling Section in conducting DSM2 simulations.

Estimation of Carriage Water for Summer of 2007 Using DSM2,
Abdul Khan, Andy Chu, and Tracy Hinojosa (CA DWR)

The Project Operations Planning Branch of the Operations & Maintenance Division of DWR has the responsibility of adapting State Water Project (SWP) operations for optimizing water deliveries, while adhering to existing regulatory and environmental requirements. In spring 2007, due to several regulatory and environmental constraints such as Vernalis Adaptive Management Plan (VAMP), Middle and Old River flow objectives, and pumping curtailments to minimize Delta smelt entrainment at the export facility, the SWP's ability to export water from the Delta was greatly reduced. As a result, the project was reoperated and divertible water was backed up at Oroville reservoir. In addition, water purchased as part of the environmental water account (EWA) for meeting the environmental requirements at the Delta was assigned as a credit to the SWP. This water, also backed up at Oroville reservoir, was available for export when feasible to do so. The reoperated as well as the EWA water was exported during summer of 2007 (July 1 through October 30, 2007). However, during this period, exporting the backed up water resulted in an additional water cost called carriage water, defined as the marginal water export cost (i.e., the additional water quantity) needed to carry a unit of water across the Delta to the pumping plant for export while maintaining an equivalent salinity level. As part of the carriage water analysis, observed data and DSM2 simulated results were evaluated at several locations such as Port Chicago, Chipps Island, Collinsville, Emmaton, Jersey Point, and Bethel to investigate their potential to be used as control points for comparing salinity levels for with and without transfer scenarios. Based on the analysis, while both Jersey Point and Bethel appeared to be reasonable choices under the given set of conditions, Bethel was concluded to be the most appropriate choice for the control point.

Status and Update on DSM2 Version 7, Eli Atelevich and Qiang Shu (CA DWR)

Abstract not available.

1:00-2:40 p.m.

Session Thirteen: Status and Trends: Putting 2007 in Perspective

Moderator: Randy Baxter (CA DFG)
Location: Chapel

Introduction to the Workshop, Chuck Armor (CA DFG)

Abstract not available.

Happy as a Clam: The Environmental Monitoring Program's Benthic Element, Karen Gehrts (CA DWR)

Abstract not available.

Phytoplankton Community Composition: The Rise of the Flagellates, Tiffany Brown (CA DWR)

Abstract not available.

Zooplankton Distribution and Abundance Trends in the Upper San Francisco Estuary, April Hennessy (CA DFG)

Abstract not available.

Abundance and Distribution Trends of Demersal Species in the Upper San Francisco Estuary, Max Fish (CA DFG)

Abstract not available.

Distribution, Trends, and Abundance of POD Species in the Upper San Francisco Bay Estuary, Dave Contreras (CA DFG)

Abstract not available.

3:00-5:00 p.m.

Session Fourteen: IEP / CWEMF Joint Modeling Session – Conceptual or Quantitative: How Do You Prefer Your Model?

Moderator: Kevin Reece (CA DWR)
Location: Chapel

From Concept to Utility: The Use of Conceptual Models in Ecosystem Restoration Planning, Bruce Herbold (US EPA)

Abstract not available.

What's Driving Spring-Run Chinook Populations?, Jody Lando (Cramer Fish Science)

Abstract not available.

The IOS Salmon Model: An Interactive "Blackboard" for Managers Evaluating Alternative Facilities, Operations and Enhancement Actions, Brad Cavallo (Cramer Fish Science)

Abstract not available.

A Fishy Tale: Splittail Population Dynamics and Delta Water Management, Ted Foin (UC Davis)

Abstract not available.

California and Environmental Water Modeling Forum, Tara Smith (CA DWR)

Abstract not available.

Coastal Margin Observatories: What Role in Sacramento-San Joaquin Delta Issues?, Antonio M. Baptista (Oregon Health and Science University)

Abstract not available.

4:15-6:00 p.m.

Session Fifteen: Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) Conceptual Models: Processes, Habitats, Stressors, and Species

Moderator: Darcy Jones (CALFED)
Location: Heather

DRERIP Transport Conceptual Model: Delta Hydrodynamics, Jon Burau (USGS)

This model gives readers a *sense* of how transport processes work in the Bay-Delta through heuristic discussions and examples based on validated numerical model results and analysis of data. A web-based approach is used to navigate the complexity of the transport processes by using a series of flow charts and "clickable" boxes with informational text. This approach simultaneously provides: (1) a big-picture perspective; (2) general descriptions of key transport processes (advection, dispersion, gravitational circulation); and (3) a framework where the subtleties of process interactions occurring in specific areas of the Delta at specific times of the year can be investigated. The model begins from the left with first principles and the forcing mechanisms in the DRIVERS box, and ends on the right with the transport of "X" in the OUTCOMES box, where "X" is water or anything in suspension in the water. The critical linkage between the first principal/forcing mechanism and the transport of "X" is system geometry. System geometry controls how the coupling between hydrodynamic processes and ecological systems respond to various interactions of forcing mechanisms. Changes in geometry can create profound changes in transport characteristics in the system and, therefore, can have a profound effect on ecosystem function. The linkages between hydrodynamic forcing, system geometry and ecosystem function are poorly understood. Yet, these linkages may hold the keys to restoring the health of the Bay-Delta ecosystem.

Contributors: Chris Enright (CA DWR), Stephen Monismith (Stanford University) and Mark Stacey (U.C. Berkeley)

A Conceptual Model for Central Valley Floodplains,
Jeff Opperman (U.C. Davis and The Nature Conservancy)

Floodplains in the Central Valley provide numerous ecological benefits including essential habitat for several species of concern, such as Sacramento splittail and Chinook salmon. Algal productivity within floodplains can also provide biologically available carbon to the Delta. Thus increasing the extent of floodplains and improving their ecological function is an important component of regional restoration strategies. This conceptual model seeks to inform these restoration efforts by synthesizing current information on Central Valley floodplains and highlighting the primary processes and linkages that ultimately produce outputs of management interest. The model is divided into three primary sub-models. Model 1 (Creating the Template) captures the linkages and processes that create the habitat mosaic—the physical template of a given floodplain, such as topography and vegetative communities. Model 2 (Inundating the Template) depicts how a given floodplain, with topography and vegetation created within Model 1, is inundated by river flows and other sources of water to create specific conditions within the inundated floodplain that are important to the species or processes described in Model 3. Model 3 (Management Outputs) illustrates how the inundated habitat characteristics, developed in Model 2, interact with a few other key elements to influence the production of biota of direct interest to delta restoration planners, including algae, zooplankton, splittail, and juvenile Chinook salmon.

Contributors: Betty Andrews (PWA), Larry Brown (U.S. Geological Survey), Jon Rosenfield (Aquatic Restoration Consulting) and Tina Swanson (The Bay Institute)

Chemical Stressors in the Sacramento-San Joaquin Delta – Conceptual Model,
Inge Werner (UC Davis)

The Sacramento-San Joaquin Delta ecosystem comprises many different habitat types, and is home to a large number of species. Thousands of chemical contaminants have been or are being introduced into the Delta. The conceptual model presented here is therefore general in nature, and is intended to provide a framework for more refined models for individual species, habitats and, in particular, contaminants of interest, for example selenium, mercury and pyrethroids. The model consists of three major submodels: (1) exposure assessment, which includes fate and transport of contaminants and the co-occurrence of chemicals with Delta organisms; (2) bioavailability of contaminants to Delta organisms; and (3) toxic effects assessment with the final model outcome of "population level effects". To illustrate the applicability of the chemical stressor model, we are providing an example of its implementation for a specific group of contaminants, synthetic pyrethroid insecticides. Although numerous different pyrethroids exist, the members of this group share many chemical and toxicological characteristics.

Contributors: Susan Anderson (Independent Consultant), Karen Larsen (Central Valley RWQCB) and John Oram (SFEI)

Conceptual Models for Central Valley Salmonids,
Jon Rosenfield (Aquatic Restoration Consulting)

Ecosystem restoration in California's Central Valley often focuses on benefits to this area's many endangered fish species. Among imperiled fishes in this watershed, Chinook salmon and steelhead attract significant attention because (a) they provide economic and recreational benefits, (b) they are well-recognized and loved by the public, and, (c) their life history patterns cause them to interact with all major aquatic habitat types in this area. Restoring salmonid habitat in the Central Valley is thus critically important and extremely difficult; numerous limiting factors may operate on different life-stages as these fish travel through different aquatic habitats. A suite of conceptual models was developed to distinguish among the great variety of life-history

strategies employed by Central Valley salmonids. Sub-models then assessed the likely impact of various stressors on each of several salmonid life-stages. The probable impact of each stressor was documented as was the certainty of current scientific understanding for each of these relationships. These models will allow ecosystem managers to evaluate the impact (and certainty of impact) of specific restoration activities on both steelhead and the four temporally and legally distinct runs of Chinook salmon found in the Central Valley.

Session Sixteen: 2007 CalSim-III Developments

Moderator: Hongbing Yin (CA DWR)
Location: Acacia

Where We are on CalSim-III Development, Sushil Arora (CA DWR)

The California Department of Water Resources and U.S. Bureau of Reclamation, working with consultants, are developing a new version of CalSim-II called CalSim-III. This brief presentation highlights salient features of new model, status of its development and implementation, and what is in store for this year.

CalSim-III Sacramento Valley Hydrology Updates and Extension to San Joaquin Valley Hydrology, Andy Draper (MWH Inc.) and Temoc Rios (USBR)

The Bureau of Reclamation and the Department of Water Resources are jointly developing a new version of the California Simulation model of the Central Valley Project and State Water Project operations, known as CalSim-III. An initial version of the CalSim-III model, with improvements to the Sacramento Valley portion of the model, was completed in 2006. Refinements to the Sacramento Valley portion of the model and development of a San Joaquin Valley module of CalSim-III were undertaken in 2007. Key objectives of the CalSim-III Hydrology Development Project include: increased spatial resolution in the depiction of surface water users, uses, and conveyance systems; implementation of a unified land-use-based hydrology model; and development of a spatially discrete groundwater module of similar resolution to C2VSIM. The principal components for the Sacramento and San Joaquin modules of CalSim-III are presented.

Simulating Rice Operations for Use in CalSim-III Hydrology Development, Dustin Jones (CA DWR)

Water supply requirements for rice operation were previously estimated for use in CalSim-II using the California Department of Water Resources' Consumptive Use Model. A revised analysis is now being performed to estimate rice water requirements in CalSim-III.

Direct Linkage Between CalSim-III and C2VSIM through IWFM Groundwater Module, Can Dogrul (CA DWR)

CalSim-III relies on the groundwater module of the California Central Valley SIMulation model (C2VSIM) to simulate the use of groundwater in meeting the water demand and its impact on stream flows. To simplify the connection between CalSim-III and C2VSIM the groundwater module of Integrated Water Flow Model (IWFM), the numerical engine driving C2VSIM, has been converted into a stand-alone executable program that is callable directly from CalSim-III. This presentation will detail the steps taken in developing the stand-alone groundwater module, its linkage into CalSim-III, and the benefits and shortfalls of this linkage.

Preliminary Comparison of CalSim-III and CalSim-II Model Results, Erik Reyes (CA DWR)

Representative system operations results of the Draft CalSim III Model will be compared against results from the Common Assumptions Version 9A Model.

Session Seventeen: Use of Remote Sensing Data to Estimate Land and Water Use

Moderator: Rich Juricich (CA DWR)
Location: Toyon

Application of LandSat Data to the Lower Colorado Region and Mid-Pacific Region, Jeff Miliken (USBR)

Methodologies have been developed over the past 15 years to standardize remote sensing processing techniques in order to provide consistent datasets for use in various water management activities. This presentation provides an overview of these methods, focusing on processes used to map and monitor crop types for the Lower Colorado River Accounting System. Also presented is information on a pilot project between the U.S.B.R. and CA Department of Water Resources to map urban irrigated landscape in the Delta Vision Project Area.

Determination of Crop Types using LandSat and MODIS, Peng Gong (UC Berkeley)

In Central Valley, California, crop types vary from year to year. A recent comparison based on historical county survey data indicates that the rate of crop planting change ranges between 40-70% in every 4-6 years. Timely information about crop distribution has important implications in water resource planning. We compared the potential of Landsat ETM+ data and MODIS NDVI time series data for classification of crop types in Merced County, California. The classification using 250 m resolution MODIS NDVI image series demonstrates a high distinguishing power since generally crops show different seasonal trends in NDVI. At least 12 consecutive 16-day NDVI images were needed to increase the accuracy to approximately 75%. When surface reflectance images were used, to produce the same level of overall classification accuracy as NDVI, the reflectance images can be acquired as early as the beginning of May of a year. This means that the mapping of crop types of the whole year can be accomplished at an early stage and the land use information can be employed in the agricultural management such as water resource allocation for the remaining of the year. Object-based classification using 30 m ETM+ images is also performed for the same area, and an overall accuracy of 84% is achieved. Hopefully a combination of multi-temporal images and high resolution images can be used to monitor crop types more effectively and efficiently.

Measuring Soil Moisture Using Active and Passive Radiometers, Eni Njoku (Jet Propulsion Laboratory)

Within the next five years, microwave sensors in space will provide new opportunities for acquiring regional and global information on the distribution of surface soil moisture. The new observations will provide enhancements to the predictive capabilities of numerical weather and climate models as well as improved capabilities for monitoring and predicting floods, droughts, and other natural hazards. The new satellites will carry L-band (1.4 GHz) microwave sensors, either passive (radiometers) or active (radars) or both, that are uniquely suited to acquiring soil moisture information over a wide range of vegetation and heterogeneous terrain, and under nearly all weather conditions. Radar observations can provide higher spatial resolution, while radiometer observations are less impacted by surface phenomena such as roughness, topography, and vegetation. Among the new missions to be launched in the 2008–2013 time frame are the SMOS, Aquarius, SMAP, and PALSAR missions. These use different but complementary technological approaches to surface soil moisture sensing. There are many opportunities, and research needs to be addressed in utilization of the new satellite data, including development of new processing and retrieval algorithms, methods for assimilating the data into hydrologic models, and applications of derived soil moisture data and products.

Application of SEBAL to Estimate Water Use, Bryan P. Thoreson (SEBAL North America)

Evapotranspiration (ET) is typically one of the largest components of hydrologic water balances, yet attention to its quantification is often inadequate. Traditional methods for estimating ET are subject to considerable error and bias, even when applied carefully. In the development of water balances, error in the various flow path estimates, including ET, manifests as error in the water balance closure term.

The Surface Energy Balance Algorithm for Land (SEBAL) offers a useful and reliable alternative to traditional ET estimation techniques. SEBAL uses routine weather data and satellite-sensed thermal radiances to compute ET based on energy balance principles. SEBAL offers three main advantages over traditional ET estimating methods: 1) it estimates actual ET as influenced by water and nutrient availability and other factors, rather than idealized, or potential ET (resulting in increased accuracy), 2) it provides spatially discrete ET estimates at the resolution of the remotely sensed data (resulting in increased precision), and 3) it can reduce ET estimation costs for large areas. SEBAL theory and validation are described in general. Examples of actual ET and ET variability estimated by SEBAL are presented for different land cover classes.

7:00-9:00 p.m.

Session Eighteen: Keynote Speaker and Social II

Moderator: IEP Representative
Location: Chapel

Keynote Speaker: Tracy Collier, Director of NOAA's Environmental Conservation Division, Northwest Fisheries Science Center

Talk Title: Fish Health, from Mechanistic Studies to Population Models, as a Tool for Assessing Effects of Chemical Contaminants

Abstract not available.

2008
Annual Meeting
Abstracts

Thursday, February 28, 2008

8:15-10:00 a.m.

Session Nineteen Post-PPIC Technical Insights for Long-Term Management of the Delta

Moderator: Jay Lund (UC Davis)
Location: Heather

Impact of Land Use Development and SWP/CVP Project Operations on Delta, Yiguo Liang (CA DWR)

Abstract not available.

Modeling Economic Costs to Agriculture of Increased Delta Export Salinities, Josue Medellin (UC Davis)

Abstract not available.

Previews of PPIC Delta II: Interesting Results on the Way to a Second PPIC Report on the Future of the Delta, Jay Lund (UC Davis)

Abstract not available.

Session Twenty: Integrated Watershed Modeling

Moderator: George Matanga (USBR)
Location: Acacia

HydroGeoSphere: Reclamation Ongoing Model Enhancements and Applications, George Matanga (USBR)

Optimal management of water resources over a watershed requires consideration of comprehensive restoration and long-term protection of complex ecosystems within and across water-cycle components (e.g., surface/subsurface water regimes, surface water/atmosphere). The surface-based ecosystems are closely interconnected and include aquatic habitats; riparian zones; lowlands (valley floor); and uplands (mountains). These ecosystems are known to closely interact with the subsurface water regime. In this work, surface water/atmosphere processes are not directly simulated but are treated in the form of boundary conditions. Currently, the surface-based ecosystems and subsurface water regime are respectively treated as two-dimensional systems and three-dimensional system. The riparian zones are generally small in area in comparison to the landscapes of lowlands and uplands. Therefore, in order to accurately evaluate the hydrological and ecological processes over a watershed, in terms of process simulation, it is necessary to apply a numerical model with capability to account for multiple-process scale. Success of predictive and conjunctive analyses of hydrological and ecological

processes require accurate characterization and quantification of fluid, energy and chemical exchange fluxes within and across the water-cycle components and ecosystems. Ongoing model applications and enhancements will be presented.

Testing of Subgridding and Subtiming Schemes in San Joaquin Valley, California, Jeffrey Randall, Mary Kang and Don DeMarco (HydroGeoLogic, Inc.)

Water supply reliability, water quality, ecosystem health and climate change are key issues impacting water resources in the San Joaquin Valley (SJV). These issues pose challenges for sustainable water-resource management in the SJV and across the Central Valley. To better address these challenges, it is necessary to understand the nature and extent of surface-subsurface water interactions. A robust numerical model, known as HydroGeoSphere, has been developed to simulate the surface and subsurface water-quantity, water-quality and ecosystem processes in a coupled manner. Recently, sub-gridding and sub-timing techniques have been incorporated into the model to enhance its application to large watersheds and long simulation periods. The SJV model accounts for variably-saturated subsurface flow, precipitation, irrigation, river inflows, subsurface extractions, evapotranspiration, surface water, surface-subsurface water interactions, and exchange flux at the surface/subsurface interface. The subsurface system includes discrete layers representing surficial sediments, unconsolidated overburden I, Corcoran clay (where present), and unconsolidated overburden II. HydroGeoSphere was used to simulate monthly stress periods from October to September. Potential applications for the SJV scale integrated surface-subsurface flow models include detailed water budget analyses, climate change modeling, and major river restoration projects.

HydroGeoSphere-CalSim: A Coupled Model for Evaluation of Climate Change Impacts, Mary Kang and Varut Guvanasen (HydroGeoLogic, Inc.)

Computer models are frequently used to guide decisions pertaining to the operation, planning and management of the State Water Project (SWP) and the federal Central Valley Project (CVP) water storage and conveyance systems. CalSim, developed by California Department of Water Resources and the U.S. Bureau of Reclamation (Reclamation), is the standard reservoir-river basin operational model for studies relating to the SWP/CVP system. HydroGeoSphere (HGS), developed by Reclamation, University of Waterloo, Lavaal University and HydroGeoLogic, is a distributed, fully-integrated surface-subsurface numerical model that accounts for three-dimensional variably-saturated subsurface flow and two-dimensional overland/stream flow. HGS is well suited for physically-based predictions of the impacts of climatic change with regard to surface-subsurface temperature, hydrology and water quality. The linked HGS - CalSim model provides a comprehensive tool for evaluating the impact of climate change on California's water resources in addition to analyzing water supply, water quality and ecosystem health issues in an integrated and optimal manner. Potential applications include major river restoration, ecosystem-health and water-resource management, climate change studies, and CALFED Bay-Delta Programs.

Geospatial Technology Integration with HydroGeoSphere, Lorri Peltz-Lewis and Lisa Rainger (USBR)

Integration of geospatial tools and HydroGeoSphere will facilitate application of the model to various field problems. The modeling approach is currently based on use of numerous tools to develop model input data. ArcGIS is valuable for pre-processing of input data. GridBldr is a DOS based tool that is restrictive in how it handles data and does not take advantage most of Windows system capabilities. It is however capable of generating data files that can be read by GROK and HGS. GridBldr is based on Tecplot and GMS formats. Tecplot is only capable of displaying and visualizing model results. The Tecplot output format cannot be easily applied by other software

packages. GMS from Aquaveo has been an integrative modeling technology that provides for a rich set of graphical interfaces for modeling and visualization. Reclamation has reviewed many available software technologies such as EarthVision, ArcGIS, ArcHydro Groundwater Model, EQuIS, and GMS. Aquaveo has been identified as the software package that could integrate the entire HGS.

10:15 a.m.-12:00 p.m.

Session Twenty-One: Wanger Delta Smelt Decision I

Moderator: Paul Hutton (MWDSC)
Location: Heather

Background and Summary of the Interim Remedy Decision in the Delta Smelt Case, NRDC v. Kempthorne, Linus Masouredis (MWDSC)

The Delta Smelt case, *NRDC v Kempthorne*, will significantly affect the 2008 operation of the Central Valley Project and the State Water Project. After invalidating the Biological Opinion for the Delta Smelt in May 2007, Judge Wanger held an evidentiary hearing on an interim remedy that would prescribe how the projects should be operated until a new Biological Opinion is issued. The evidentiary hearing included testimony from experts on the causes of the decline in Delta Smelt abundance, the impact of project operations on the Delta Smelt, and the efficacy of various interim remedies proposed by the parties. On December 14, 2007, Judge Wanger issued a final interim remedy order identifying fish survey and monitoring requirements, Old and Middle River flow restrictions, and physical barrier restrictions that must be implemented while a new Biological Opinion is being developed. The judge also issued a set of Findings of Fact and Conclusions of Law that provide the rationale for the remedy order.
This presentation will describe the background of the delta smelt litigation, the substance of the remedial order, and areas where modeling studies might be helpful in addressing some of the issues raised in the Delta Smelt litigation.

Estimating Combined Old and Middle River Flow, Paul Hutton (MWDSC)

The abundances of Delta smelt and other pelagic fish species have declined dramatically over the last several years. These population declines are thought to be influenced by chemical pesticide exposure, food-web alterations, and water project entrainment. Studies are ongoing by the Interagency Ecological Program and others to define and understand the nature of these population declines. One such study found a correlation between Delta smelt salvage at the CVP-SWP export pumps and combined Old and Middle River flows near Bacon Island. This correlation was a motivating factor to limit upstream (reverse) flows in Old and Middle Rivers. The current configuration of the Delta relies on Old and Middle Rivers to convey water from the Sacramento River to the CVP-SWP export pumps, a pathway that results in reverse flows. Since regulation of these reverse flows can have significant impacts on water project operations, accurate methods are needed to forecast Old and Middle River (OMR) flows. This presentation will review the hydraulics of OMR flows and describe the development of a new empirical model to estimate OMR flow. The new model was designed as a long-term planning tool that can be incorporated into CALSIM; however, the model also has applicability to short-term operations planning.

CALSIM Estimates of Potential CVP-SWP Water Supply Impacts of the Wanger Decision, Armin Munevar (CH2M Hill)

Abstract not available.

IRPSIM Estimates of Potential MWD Water Supply Impacts of the Wanger Decision, Brandon Goshi (MWDSC)

Over the past 15 years, the Metropolitan Water District has been developing a diverse portfolio of water resources to meet the demands of its service area. The State Water Project plays a major role in this portfolio, not only providing water deliveries in dry years, but also providing water for storage programs. The Wanger Decision is expected to place limits on State Water Project exports. A new range of potential deliveries from the State Water Project will place additional pressure on Metropolitan's resources. This presentation will provide an overview to the technical approach that Metropolitan in its planning efforts, and show how the Wanger Decision affects Metropolitan's entire resource portfolio.

Session Twenty-Two: Uncertainty and Sensitivity Analysis in Simulation and Optimization Models

Moderator: Tariq Kadir (CA DWR)
Location: Acacia

Do More with Sensitivity and Uncertainty Analysis with Less Effort: Introduction to Automated Inverse Modeling Tools with Practical Examples,
Stephen Mehl (CSU Chico / USGS) and Laura Foglia (UC Davis / Larry Walker & Assoc.)

UCODE_2005 is a computer program that performs inverse modeling tasks, such as sensitivity analysis, data needs assessment, calibration, prediction, and uncertainty analysis. It is a universal tool that can be used with any model (or set of models) that work with text (ASCII) input and output files. UCODE can be used in both simple and very complex modeling studies to diagnose inadequate data, identify difficult to estimate parameters, evaluate estimated parameter values, and evaluate how well the model represents the simulated processes. This presentation is divided into two parts. The first introduces some capabilities of UCODE and how to interpret and use some of the basic output. The second uses a more complicated modeling study to show how UCODE can use these methods to improve the understanding of the model, the data, and the simulated processes. The examples presented include application of UCODE to both groundwater and surface water models.

Sensitivity and Uncertainty Analysis in Optimization-Driven Models,
David Rheinheimer and Jay Lund (UC Davis)

For large models, the effects of uncertainty in particular inputs on model outputs can be difficult to quantify and understand. There are numerous ways to quantify model sensitivity, each with advantages and disadvantages. In linear programming (LP) models, there is often uncertainty in the cost coefficients/priority weights, constraint coefficients, and constraint values. Fortunately, some by-products of LP solutions can help quantify sensitivity in LP models, including the range-of-basis (allowable range in cost coefficients or constraint coefficients) slack/surplus, and Lagrange multipliers (constraint shadow values). We can use these by-products to perform an uncertainty-weighted sensitivity analysis. Uncertainty-weighted indices were developed based on range-of-basis, slack/surplus, and Lagrange multipliers and applied to CalSim-II. Preliminary results are presented and compared with a traditional sensitivity analysis conducted by the California Department of Water Resources.

Uncertain about Uncertainty? Understanding Uncertainty and its Role in Water Resource Decisions, Alaa Aly and Marsh Lavenue (INTERA, Inc.)

Designing hydraulic and water resources engineering systems inherently involves some professional judgment when accounting for uncertainties associated with all aspects of the system. These uncertainties are attributed to the lack of perfect knowledge concerning the phenomena and processes involved in problem definition and resolution. Uncertainties in hydraulic engineering system design can be divided into four basic categories: hydrologic, hydraulic, structural, and economic (Mays and Tung, 1992). Hydrologic uncertainty can further be classified into inherent, parameter, or model uncertainty. Hydraulic uncertainty refers to the uncertainty in the design and performance of hydraulic structures. Structural uncertainty refers to failure from structural weaknesses. Economic uncertainty can arise from uncertainties in various cost items, inflation, project life, and other intangible factors. In general, uncertainty arising because of the inherent randomness of physical processes cannot be eliminated. This presentation will provide a general description of recent developments in the quantification and analyses of water resources systems under uncertainty. Case studies will be briefly described to illustrate how these techniques are used and the resources required to deal with these systems.

1:15-2:00 p.m.

Session Twenty-Three: Pop-Up Talks II

Moderator: Nigel Quinn (LBNL/USBR)
Location: Heather

Pop-Up Talks: Five-minute overviews summarizing California water and environmental modeling work.

1:15-3:00 p.m.

Session Twenty-Four: Dealing with Modeling Uncertainty: Producing Reasonable Results for Decision Makers

Moderator: Walter Bourez (MBK Engineers)
Location: Acacia

Dealing with Uncertainty in Water Operations Modeling, Walter Bourez (MBK Engineers)

Abstract not available.

**Uncertainty with CalSim Operation for the San Joaquin River Basin, CVP/SWP System South of the Delta and Sacramento River Basin,
Lee Bergfeld and Walter Bourez (MBK Engineers)**

Abstract not available.

**Uncertainty in Ground Water and Surface Water Models for Sacramento Valley,
Peter Lawson (CH2M Hill) and Lee Bergfeld (MBK Engineers)**

Abstract not available.

Uncertainty with Delta Salinity Modeling with DSM2, Russ Brown (JSA)

Abstract not available.

2:15-4:30 p.m.

Session Twenty-Five: Wanger Delta Smelt Decision II

Moderator: Paul Hutton (MWDSC)
Location: Toyon

Estimating Delta Smelt Salvage, Bryan Manly (Western EcoSystems Tech. Inc.)

A log-linear modeling approach for the prediction of daily salvage numbers at the Banks and Jones Pumping Stations using river flow rates and other variables will be described. This includes a search for the best model out of all possible models subject to various constraints in terms of the prediction of past salvage numbers. A high proportion of past variation in Banks salvage numbers has been accounted for, but this has not always been the case for Jones salvage numbers, possibly because the best predictor variables have not yet been determined in this case.

Operation of the Suisun Marsh Salinity Control Gate, Chris Enright (CA DWR)

The Suisun Marsh Salinity Control Gates (SMSCG) were completed and began operating in October 1988. The facility consists of a boat lock, a series of three radial gates, and flashboards. The SMSCG controls salinity by closing on flood tides and opening on ebb tide, thus inducing a net downstream net flow in Montezuma Slough. When Delta outflow is low to moderate and the SMSCG are not operating, net flow is near zero allowing dispersion of higher salinity water in Montezuma Slough. The SMSCG is permitted to operate between October 1 and May 31 only when needed to meet salinity standards in Suisun Marsh. When the channel water salinity decreases sufficiently below the salinity standards, or at the end of the control season, the flashboards are removed and the SMSCG raised to allow unrestricted tidal currents through Montezuma Slough. As of 2005, the boat lock is held open during gate operation to facilitate salmon passage.

Modeling Delta Smelt Entrainment with PTM, Yiguo Liang (CA DWR)

A combined SWP-CVP Entrainment Index for delta smelt was developed based upon DSM2 hydrodynamics and Particle Tracking Model simulations of historical conditions and delta smelt surveys. Relationships at delta smelt survey locations were developed between Old and Middle River flow or QWEST and the portion of injected particles entrained in Clifton Court Forebay and Jones Pumping Plant. Then a Delta-wide SWP-CVP Entrainment Index was calculated, given an average Old and Middle River flow or QWEST over a specified period of time and the results of a delta smelt survey. This index was then compared to historical salvage data to test its potential as a component for predicting delta smelt salvage.

Modeling Delta Smelt Population Dynamics, Rick Sitts (MWDSC)

Population effects of pumping restrictions imposed by Judge Wanger to protect delta smelt from losses at the pumps, and the associated water costs, were evaluated to see what difference they might make to the population and at what water costs. We estimated effects and costs with a delta smelt population model, integrated with hydrologies per Paul Hutton's preceding talk with and without Wanger rules. Losses at the pumps are based on equations predicting daily salvage of adult delta smelt, or the percent of the larval/juvenile population near the pumps, per Bryan Manly's preceding talk. We adjusted losses with life-stage-specific survival rates developed from agency field survey data, and with year-specific larval/juvenile survival rates per Phil Unger's

conference poster. The difference in December-June exports is the water cost. Results depend on sampling efficiencies, seeding, flows and other specifications. For a 1996-2005 run, modeled increases in abundance predictions among years for juvenile delta smelt, without Wanger and with his most protective Old and Middle River flow of -750cfs, ranged from 0 to 14M (26%), while water costs ranged from 234 to 1,720 taf, depending on the year; however, considerable uncertainty is involved. Thus, population modeling indicates in some cases and with some uncertainty, potential increases in delta smelt abundance and water cost given a specified flow regime.

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Poster Session Titles

How to Get 3-D Accuracy with a 2-D Stream-Aquifer Interaction Model, Hubert Morel-Seytoux (Hydroprose International Consulting)

In the vicinity of a river (or canal) reach the Dupuit-Forchheimer (D-F) assumption does not hold. In order to treat the problem accurately one would need to use a 3-dimensional model with small cells in the vicinity of the reach. Given the usually small horizontal spatial extent of the reach footprint, one may legitimately wonder if there might not be an approximate yet adequate way to avoid this extra complication? In the 1940's and 50's, it was assumed for simplicity, that the stream had no width and fully penetrated the aquifer. With the assumption of full penetration no resistance is accounted for the difficulty the flow encounters to change direction from a vertical to a horizontal one. The purpose of this investigation is to compare the results of an analytical approach for this added resistance "turning" factor with those obtained with: (a) the assumption of full penetration and (b) a Finite Difference grid. Compared to the analytical results it is shown that the assumption of full penetration severely overestimates the discharge and that the finite difference grid approach grossly underestimates it. A potentially very practical tool has been suggested for a numerically efficient and adequately accurate 2-dimensional alternative to a full detailed 3-dimensional modeling. There is little need for a detailed grid description of the reach cross-section. In fact the full penetration assumption can be used provided that the flow across the reach vertical boundary be corrected by the turning factor. What has been quantitatively demonstrated, albeit for a certain cross-section shape, is that neither the traditional assumption of full penetration nor the use of a typical Finite Difference grid model will provide adequately accurate results. However it must be emphasized that it is not necessary to proceed to a 3-dimensional groundwater model to improve accuracy but rather correct the manner in which the seepage discharge is calculated while conserving a typical two-dimensional Finite Difference grid.

Wetland Response to Adaptive Salinity Drainage Management, Ric Ortega (UC Davis) and Phil Duffy (UC Merced)

The 180,000 acre Grassland Ecological Area constitutes the largest contiguous wetland complex remaining in California. It is a significant waterfowl wintering area, as well as an important migration stopover site for shorebirds and raptors. Wetlands in the San Joaquin Valley are intensively managed to produce standing crops of moist soil food plants and invertebrates with high value to wildlife, particularly waterfowl. The most abundant moist soil plant managed and selected for in the Grassland Wetlands is swamp timothy grass (Crypsis schoenoides). The Central Valley Regional Water Quality Control Board has adopted a conditional waiver of Waste Discharge Requirements for discharges from irrigated lands, which requires characterization of wetland water quality, and a salt and boron TMDL limiting the amount of salt and boron that can

be discharged into the San Joaquin River at certain times of the year during certain years. Wetland managers are being asked to modify the hydrology by draining their swamp timothy managed wetlands later in the spring when there is assimilative capacity in the San Joaquin River. However, wetland managers are concerned that altering the hydrology in managed wetlands will adversely impact the productivity of these wetlands over time. The focus of this study is to investigate the impact of altered spring drawdown of managed wetlands to plant productivity wetland salinity and waterbird use in the Grassland Wetlands of the Northern San Joaquin Valley within the Lower San Joaquin River Watershed. We seek to answer the following question: does altering the timing of discharge from managed wetlands to the San Joaquin River effect wetland salinity and subsequently the productivity, distribution, and forage value of wetland plants for resident and migratory shorebirds and waterfowl? The goal of this project is to determine how wetland productivity, water quality and waterbird use is impacted by changes in traditional management of swamp timothy wetlands within the Grassland Wetlands. To determine how management affects the salinity and productivity of swamp timothy wetlands within the Grasslands, we will map and monitor spatial change within the basic habitat types of each wetland cell utilizing high resolution aerial photography, soil salinity mapping equipment, and GIS in conjunction with in the field ground truthing efforts. We will collect mature clip samples of swamp timothy to monitor yearly above ground biomass and seed production. We will investigate correlations between soil salinity and swamp timothy seed and biomass production to assess soil salinity tolerances. We will then compare swamp timothy productivity, soil salinity and spatial distributions of moist soil habitat types between traditionally managed wetland cells with those that are managed in response to San Joaquin River assimilative capacity load targets for salt. We will provide this information to wetland managers to help develop best management practices for managed wetland habitat within the San Joaquin River Basin.

Uses of Watershed Modeling, George Nichol (SWRCB)

A schematic of a watershed is presented showing the uses of watershed models. Some watershed conditions that can be addressed with watershed models are local and regional watershed planning, urban drainage design, design and real-time operation of flood control projects, regulating floodplain activities, monitoring water use, determining urbanization impacts on peak flows and timing, water availability studies, flow forecasting, reservoir spillway design, and determining flood damage reductions.

SEBAL Applications and Studies: Worldwide and Western United States, Bryan Thoreson (SEBAL North America)

Evapotranspiration (ET) is an important component of hydrologic water balances because water leaving the Earth's surface as ET is consumed, becoming unavailable for use until it returns as precipitation. Due to ET commonly being the largest outflow from water balances at the Earth's surface, accurate quantification becomes critical to reduce uncertainties in water balance closure terms. Often, water balances at the Earth's surface use independent estimates of inflows, ET, changes in soil moisture storage, and surface runoff to solve for deep percolation as a closure term for evaluation of water management alternatives. Relatively small uncertainties in ET translate into large uncertainties in the closure term(s), which has important implications to water management decision-making.

Traditional methods of ET estimation are subject to considerable error and bias, even when applied carefully. This is particularly true for natural landscapes, including riparian and wetland areas as well as urban areas, but it is also true even for well researched, commercially grown crops. Uncertainties arise largely from reliance on traditional methods that utilize empirical relationships between reference ET and actual ET that, while representative of the conditions

under which they were developed, are unable to capture the range of actual conditions that exist across the terrain.

Alternative methodologies exist to quantify ET more accurately and precisely across a range of surfaces. The Surface energy Balance Algorithm for Land (SEBAL), a remote sensing approach to solving the energy balance at the Earth's surface, can be used to directly estimate ET over small and large areas based on actual conditions. SEBAL utilizes satellite-sensed spectral radiances and routine ground-based weather information in series of 25 computational procedures to compute ET for each pixel in a satellite image. Spatially and temporally distributed ET estimates from SEBAL have provided valuable insights to water managers and policy makers throughout the world since the mid-1990's.

SEBAL offers three distinct advantages over traditional ET estimation methods: 1) it estimates actual ET as influenced by water and nutrient availability along with other factors, rather than idealized, or potential ET (resulting in increased accuracy), 2) it provides spatially discrete ET estimates at the resolution of the remotely sensed data (resulting in increased precision), and 3) it reduces cost for large areas compared to traditional methods because calculations can be made simultaneously over large areas using readily available data. This poster identifies several domestic and international SEBAL applications with a special focus on the Western United States. Results of recent validation studies conducted in the Western United States are summarized.

Modeling the Hydrological Impacts of Climate Change: Western Slope of the Sierra Nevada, Chuck Young (Stockholm Environment Institute)

A new data set enhances the abilities of researchers and decision-makers to assess possible future climates, explore societal impacts, and approach policy responses from a risk-based perspective. The data set, which consists of a library of 112 fine-resolution climate projections, based on 16 climate models and three greenhouse gas emissions scenarios, is now publicly available. Monthly climate projections from 1950 to 2099 were downscaled to a spatial resolution of 1/8° (about 140 square kilometers per grid cell) covering the conterminous United States and portions of Canada and Mexico.

For the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, climate modeling groups produced hundreds of simulations of past and future climates. These simulations are located in an archive (at the Program for Climate Model Diagnosis and Intercomparison at Lawrence Livermore National Laboratory (LLNL). A remaining issue is that the spatial scale of climate model output is typically too coarse for regional impact studies.

To facilitate regional climate change impact studies, the U.S. Bureau of Reclamation's Research and Development Office, LLNL, the University of California Institute for Research on Climate Change and Its Societal Impacts, and Santa Clara University (through support from the U.S. Department of Energy's National Energy Technology Laboratory) developed a public-access archive of downscaled projections.

A statistical technique [Wood et al., 2004] was used to generate gridded fields of precipitation and surface air temperature over the conterminous United States and portions of Canada and Mexico. The method involves (1) a quantile-mapping approach that corrects for GCM biases, based on observations of 1950-1999; and (2) interpolation of monthly bias-corrected GCM anomalies onto a fine-scale grid of historical climate data, producing a monthly time series at each 1/8-degree grid cell. The method has been used extensively for hydrologic impact studies (including many with ensembles of GCMs [e.g., Maurer, 2007]) and in a variety of climate change impact studies on systems as diverse as wine grape cultivation, habitat migration, and air quality. The downscaled data are freely available for download at the Green Data Oasis, a large data store at LLNL for

sharing scientific data (http://gdo-cp.ucllnl.org/downscaled_cmip3_projections/). Users can specify particular models, emissions scenarios, time periods, geographical areas, and raw data or summary statistics. All data are archived in a standard netCDF format, a self-describing machine-independent format for sharing gridded scientific data.

A Library of Downscaled Climate Simulations for Societal-Impacts Assessments, Phil Duffy (LLNL)

Abstract not available.

Calculating the Volume of Jones Tract using LiDAR Data, Jane Schafer-Kramer (CA DWR)

On a sunny June day in 2004, a levee along Bacon Island Road in San Joaquin County breached, allowing the Middle River to inundate the farmland of Jones Tract. Like the other man-made islands in the Delta, the land elevation of Jones Tract is below sea level. If the island was to be reclaimed, flood water would have to be pumped out. One of the issues that local Reclamation District and State Department of Water Resources (DWR) engineers had to address was calculating the volume of water in the newly-formed lake. An accurate estimate of the water volume was needed for preparation of the pump-out contract, and it was also required for water quality (dissolved organic carbon) studies. USGS topological maps were used to estimate the elevation of the land surface, but the knowledge that subsidence of the peat soil is an ongoing process in the Delta cast some doubt on the accuracy of the available elevation data. Estimates of the actual volume of water to be pumped varied widely, from 97 TAF to 180 TAF.

In 2007, a LiDAR (light detection and ranging) survey of the Delta was conducted by DWR, and the draft dataset of the land elevation is now available. This poster illustrates how LiDAR data can be used with GIS (Geographic Information Systems) to calculate the volume of a flooded island.

Land Atmosphere Water Simulator, Michael Tansey (USBR)

The Land Atmosphere Water Simulator (LAWS) is an integrated, flexible, and scalable suite of tools for efficiently developing and comparing alternative water management strategies with either historical or forecasted water supply conditions. LAWS provides users with the capability to evaluate alternative water management strategies based on multiple factors including:

- Delivery priorities
- Reservoir and conveyance infrastructure
- Irrigation system characteristics
- Crop types
- Soil moisture management practices
- Groundwater and drain water recycling

LAWS provides users with tools to simulate alternative methods for managing soil moisture on a daily basis during the irrigation season based on soil properties, crop types and growth stage. LAWS makes field scale calculations of important plant, soil and water budget characteristics including:

- Evapotranspiration
- Soil water content
- Depth of ponding and tail water runoff
- Deep percolation
- Conveyance and drain losses
- Return flow to river

LAWS gives users with ability to aggregate these results within larger user definable areas so that water budgets can be readily computed for arbitrary organizational regions. LAWS has a powerful graphical user interface (GUI) that allows users to readily change water allocation and sources, land and crop management practices, weather conditions, and infrastructure characteristics to compare the effects of alternative system configurations on reservoir water supplies. LAWS has a native GIS capability built directly into the GUI which provides users with the capability to import geo-referenced imagery, maps, and GIS information developed with commercially available software packages.

Come Play the DSM2 Evaluation and Calibration Game with Us,
Jamie Anderson and Kevin Kao (CA DWR)

The previous calibration of Delta Simulation Model II was completed by Interagency Ecological Program (IEP) Work Team in year 2000. The motivations for DSM2 recalibration are as follows: (1) Field data availability has increased since year 2000, i.e., bathymetry, flow, stage, and water quality, (2) DSM2 capabilities have been expanded to represent more hydraulic structures, e.g., gate operations, (3) Delta Consumptive Use model has been improved DSM2 recalibration necessity will be assessed by selected performance metrics (e.g., Root-mean-square error or Nash-Sutcliffe model efficiency coefficient) and comparing quality assured/quality controlled field data. If recalibration is deemed necessary, then the calibration parameters will be chosen and success criteria will be defined. The evaluation and potential recalibration for DSM2 will be open and cooperative. Public participation is encouraged at all steps of the process.

Multi-dimensional Surfacewater Modeling for Restoration and Impact Analysis,
Kyle Winslow, Don Kingery and Chandra Chilmakuri (CH2M Hill)

Multi-dimensional hydrodynamic models are an efficient tool to analyze benefits of proposed restoration efforts and quantify impacts of engineering projects. The results of hydrodynamic models can then be used to drive sediment transport and water quality models, extending the usefulness of these models. Examples of such numerical investigations include:

- Analysis of distribution of freshwater diversion of Mississippi River water into Southern Louisiana wetlands to reduce saline conditions;
- Analysis of hydraulics and sediment transport for proposed river realignment and restoration project on the Trinity River in Dallas, Texas;
- Analysis of channel velocities for use in determination of channel stability in restoration of tidally influenced Oleta River, Florida;
- Analysis of circulation patterns and contaminant transport in Grays Harbor, Washington;
- Analysis of hydraulics and fate of nutrients for use in design of treatment wetlands;
- Analysis of fate and transport of turbidity plume associated with dredging activities during construction of a container terminal on the Elizabeth River near Portsmouth, Virginia.
- Analysis of fate and transport of effluent discharge from a fertilizer plant in the Alafia River estuary near Tampa, Florida;
- Analysis of three-dimensional hydrodynamics near Juneau, Alaska, for use in impact analysis of proposed submarine tailings discharge.

Water Quality in Sacramento-San Joaquin Delta - A Case Study at Barker Slough, Seungjin Baek (PWA)

The Barker Slough Pumping Plant (BSPP) provides water for the Cities of American Canyon, Benicia, Calistoga, Fairfield, Napa, Vacaville, Vallejo and Yountville, as well as for Travis Air Force Base. Located on the north shore of Barker Slough, one half-mile east of State Highway 113, BSPP pumps water into the 27-mile long North Bay Aqueduct (NBA) and ends at the Napa Turnout Reservoir. A 2-dimensional hydrodynamic model is calibrated to determine how water quality at the BSPP could be impacted by inflows from nearby tributaries and potential changes in Delta conditions, such as a hypothetical levee break resulting in reduced water quality in the Sacramento River. In order to estimate the influence of each tributary on the BSPP, different types of passive scalars are introduced at each tributary inflow. These scalars allow for three flow condition scenarios: dry season, wet season with Yolo Bypass spilling and wet season without Yolo Bypass spilling. Under the wet season scenario, with large inflows from the Yolo Bypass, when the Fremont Weir is spilling, the model predicts that during medium to large events, the major source of water pumped at BSPP comes predominantly from Campbell Lake. However, under the dry season scenario, when tributary inflows are very low or zero, Barker Slough and Lindsey Slough are predicted to be the predominant sources of water pumped at BSPP.

Contributors: Chris Bowles, Mikkel Andersen, Alex Rabidoux and David Okita

Sierra Nevada Watershed Conservation Plan,
Michael Deas (Watercourse Engineering, Inc.)

The UC Davis Center for Watershed Sciences is spearheading the largest climate change modeling exercise to focus specifically on the Sierra Nevada, California. In cooperation with Stockholm Environment Institute and Watercourse Engineering, researchers are integrating several spatially explicit models, including rainfall-runoff and stream temperature, to synthesize hydrological changes in the Sierra Nevada under climate warming scenarios. Using 14 major basins of the Sierra Nevada, we characterize the current status of Sierra Nevada watershed integrity, to serve as the underlying basis for integrated models depicting 2°, 4°, and 6° C warming. Subsequent analyses will then access standardized spatial data on the physical, ecological, jurisdictional, hydrological, and meteorological conditions for the entire study region in a single integrated framework. Our approach provides a robust and dynamic data framework to be used in project evaluation, cross-basin comparative analyses, and scenario modeling of future conditions. This project is generously funded by the Resources Legacy Fund Foundation.

Contributors: Jeff Mount, Peter Moyle and Josh Viers (UC Davis), Leon Basdekas (Watercourse Engineering, Inc.), David Purkey and Charles Young (Stockholm Environmental Institute)

Shasta River Flow and Water Temperature Simulation Modeling, Sarah Null (UC Davis)

Low instream flow and high water temperature conditions are two factors limiting survival of native salmon in California's Shasta River. This study examines the potential to improve fish habitat conditions by better managing environmental water quantity and quality. The Tennessee Valley Authority's River Modeling System (RMSv.4) was used to simulate flow and water temperature to evaluate potential restoration alternatives. Although there is uncertainty in input data, this analysis largely constrains the problem to provide a reasonable estimate of current and potential flows and temperatures for a representative year in the Shasta River. Results suggest a combination of restoration alternatives is needed to improve instream habitat for native salmon species in the Shasta River. It also indicates that substituting higher quality water can sometimes benefit native species without increasing environmental water allocations.